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NPIC/TDS/E-445/67
14 November 1967

MEMORANDUM FOR: [] DS/ESB

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SUBJECT: 10X Objective Lenses as Used in []
Micro-Analyzer

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1. In response to your request, the above mentioned lenses were secured from [] of TID and were checked on an optical bench to determine the spread of the focal planes for red, green, and blue. The lenses in question were standard [] 10X objectives designed to be used without cover glass at a 215mm tube length. The only apparent modification was the blackening of all interior metal surfaces. In the Micro-Analyzer they are being used at tube lengths of approximately 18 inches.

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2. A check of the lenses with no cover glass at 18-inch tube lengths indicated a spread in excess of 150μ between green and blue focus on the object plane, or 3mm in the image plane of the objectives. When a cover glass approximating the thickness of the support plate for the film was used between the object plane and the lens, this spread increased appreciably. The in-focus resolution for each color was in excess of 900 lines/mm

3. When the lenses were tested at the correct tube length the spread between colors was reduced to less than 5μ in the object plane. This figure is approaching the precision of the experiment. The tolerance given on tube length for a 10X .25NA objective is ± 40 mm for a 160mm tube length for normal work (biological) and much less than this for critical work.*

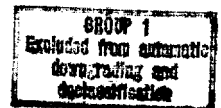
4. It is concluded that the focussing problem outlined above (focus is a function of wave length) is strictly a matter of using lenses in a mode for which they were not designed.

5. It is recommended that either the existing lenses be modified or new lenses be designed for the appropriate tube length. It is also suggested that the top lens be specified for use with no cover glass as in the original specification, but at the correct tube length; however, the bottom lens should include also the specification that it is to be designed for viewing through a glass stage of the appropriate thickness.

* Rudolph Kingslake, Applied Optics and Optical Engineering, Vol. III, p. 160, Academic Press, New York, 1965

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6. Two other courses are open; however, both have disadvantages which may cause problems. The first is the use of an appropriately selected relay lens in both the illumination and the imaging legs of the optical train. The two lenses would be different due to the cover glass requirement. This would call for selection or design of the appropriate lenses plus some mechanical modifications to the Micro-Analyzer to mount them. The second course would be to investigate the suitability of a lens such as the [] Micro-Tessar Photomicrographic lens in this application. Unfortunately, this lens is only available with f4.5 aperture or approximately N.A. 0.1 which may not be adequate for the current application.

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Distribution:

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1 - W. [] TID

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